

STRATEGIES FOR PRESERVATION OF RARE PLANTS

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ABSTRACT.— Preservation of the habitat is the only logical strategy to save endangered species from early extinction. Ecological amplitudes of rare species are very narrow, so transplantation to such alien sites as botanical gardens is not a solution. Protection may not be the answer. We must learn as much as we can about the biology of the species in question, in the field and under laboratory conditions. The first steps must be to determine the distribution. This would be followed by analysis of soils by means of physical and chemical studies. Pollination ecology, associated species, phenological records, and genetic and cytological studies must be a part of the biological studies. Such studies would require teamwork by qualified botanists.

I suspect I was asked to take this assignment because, as several of you know, I have cultivated many of our western native plant species. Most of these plants were introduced into my gardens so I could have laboratory material for my taxonomy classes. I had great success with *Penstemons* and at one time I had 33 species in this genus. Many of my *Penstemons* hybridized under prolonged flowering conditions in my gardens until it was difficult or nearly impossible to determine parents of most of my hybrids. Some of my introductions in other genera became troublesome weeds. These are not the kinds of species we are concerned with in this symposium.

I will devote my time to strategies for preservation of rare plants. My answer and only logical strategy is to preserve the habitat of the threatened and endangered species so that we may save them from early extinction. Species inevitably become extinct, in times past by natural forces, but in recent times greatly accelerated by man's destructive activities.

Extant knowledge of rare species indicates that ecological amplitudes are very narrow and thus transplantation to such alien sites as botanical gardens is not a solution. And still, *Franklinia alatamaha* Marsh was preserved in cultivation. The lost camellia or Franklin tree, originally from someplace in the coastal plain of Georgia, was discovered by John and William Bartram in 1765 and has not been

seen in its native place since 1790. Many botanists have searched long and hard for the lost camellia. Dr. Ritchie Bell of the Botany Department at the University of North Carolina has made several expeditions with graduate students in search for the lost camellia that has been in cultivation for nearly 200 years.

In the absence of hard data, habitat preservation is the only option open, and it is increasingly at hazard because not even the scientific community understands the problems. Habitat preservation is seen as a powerful threatening tool to the public at large and especially to those who are anxious to develop our natural resources. Elected office holders and seekers are afraid to line up with the biologist who sees the need to preserve habitats of threatened and endangered species. We have no idea yet how much area to protect or even if protection is the answer.

Two species come to mind that thrive in disturbed sites. *Astragalus paysonii* (Rydb.) Barneby is usually found in burned-over areas in Wyoming and *Mertensia toyabensis* Macbr. thrives in similar habitats in the Toiyabe Range in Lander County, Nevada. Many species make a living in disturbed sites, but it is unusual to find rare species in such habitats. Perhaps more fieldwork will show that the two species mentioned here are not as rare as we have thought.

Dr. Howard S. Irwin, president of the New York Botanical Garden, said in a letter to me

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dated 16 October 1978: "The most desperate need is a federal program that would encourage students to study the biology of species' rarity, more or less in the manner followed by Dr. Lazarus Walter Macior at Akron University in investigating the Furbish lousewort."

I contacted Dr. Macior and received a prompt reply dated 14 November 1978. Dr. Macior enclosed a copy of his manuscript which will appear in the October–December 1978 issue of the *Bulletin of the Torrey Botanical Club*. All papers published in the *Bulletin of the Torrey Botanical Club* are copyrighted, so the manuscript was sent to me for my personal use only. Dr. Macior's work with the Furbish lousewort will certainly become a model for experimental studies on rare species.

The first step in a strategy for preserving rare plants must be to learn as much as possible about them in the field and under controlled conditions in the laboratory. Every effort must be made to determine the distribution of the taxon in question. *Smelowskia holmgrenii* Rollins was thought to be confined to one rock prominence in the Toquima Range, but Sherel Goodrich discovered that this unusual species was actually more common in the Toiyabe Range to the west. The known distribution at this writing includes four stations in the Toquima Range and 10 populations in the Toiyabe Range, so the species is not considered to be in the precarious situation suspected prior to the 1978 field season. This unusual mustard is a distinctive species, and, as is true so many times in this family, species are easier to recognize than the problem of assigning them to genera. I still have difficulty thinking of this species as belonging to the genus *Smelowskia*. To me, it seems to have closer affinities with the genus *Braya*, far to the north. It may turn out that we have a new genus. *Arabis shockleyi* Munz is another species that may turn out to be more common than we have thought. Only a few widely scattered collections have been made from Tooele County, Utah, to the San Bernardino Mountains in California. The paucity of collections probably illustrates how poorly some of our desert ranges are known.

Detailed field studies would vary to some

extent with different species. The *Smelowskia* of central Nevada is found in crevices of andesite rocks, and future studies on this species may show that it has a preference for this kind of a substrate. *Arctomecon humilis* Coville and *A. californica* Torrey and Fremont probably require gypsum soils, often referred to as "gumbo" clay.

Detailed biological studies would begin after the distribution of the species has been determined. Biological studies of rare species would investigate the ecological adaptations of the species as to edaphic factors and biotic environment. Soil samples would be taken from many sites and thoroughly analyzed with every sophisticated chemical and physical means we know. Weather records would be analyzed or gathered. Total precipitation means little unless we know the distribution throughout the year. Climatic characteristics in a broad sense would also include solar radiation and temperature records.

Pollination ecology may be a key as to why a species is rare and perhaps even on the verge of becoming extinct. The loss of a pollinator through spray programs may place a species in imminent danger of becoming extinct.

Phenological records should be kept and associated species recorded. What are the requirements for seed germination? Much remains to be learned about seed germination and especially for rare species. Under what conditions is flowering initiated? How soon after flowering are fruits matured, and what is the mode of seed dissemination? Are certain species usually associated with a taxon we are studying, or is a niche so inhospitable that our species has the habitat without a competitor?

Cytological studies would help in possibly determining closely related species. Dr. James Reveal and I prepared a paper several years ago on *Cilia caespitosa* A. Gray that was never submitted for publication. The chromosome number of this rare and restricted species was determined to be the same as the wide-ranging and highly variable *G. subnuda* A. Gray, $2n = 16$. *Cilia caespitosa* is restricted to white, decomposed sandstone one mile south of Teasdale in Wayne County, Utah. Dr. Dieter H. Wilken has prepared a fine paper on *G. caespitosa* in much more de-

tail, "The Status of *Gilia caespitosa* A. Gray (Polemoniaceae)," which has been accepted for publication in *Madroño*. Dr. Wilken has concluded that *G. caespitosa* has a close relationship with *G. subnuda*. Reduced specimens of *G. subnuda* are very similar to the uniform specimens of *G. caespitosa*. Dr. Wilken suggests that *G. caespitosa* may represent one of the more primitive elements within *Gilia*. In my Honor Lecture in 1977 at Utah State University in Logan, Utah, I pointed out that this beautiful little perennial may have arisen from an extreme biotype of the variable and common *G. subnuda*. If a widespread species becomes established in an unusual edaphic situation, it will carry only a small part of the genetic variability of the original species. Inbreeding and random fixation will tend further to make this insular population more uniform and still more different from the ancestors as the years of isolation continue. The individual plants of this beautiful species appear to be as nearly genetically alike as separated parts of a clone. It does not seem logical that this species is a senescent species. It probably evolved where it is found today and adapted to a single ecological niche. It seems unlikely that it occupied a larger area in past times.

The biological studies outlined above are all a part of the first phase in learning about rare species, but the studies obviously do not stop here. If the species is threatened in part of its range, some natural populations must be preserved in situ for further study. This is especially true for the three species of *Arctomecon*. Each species is confined to a precarious habitat and all three are fast disappearing. The fact that requirements for seed germination are not known and that the plants cannot be transplanted make it imperative that these plants be studied in situ. Housing developments, trail bikes, and gypsum processing plants doom at least two of these bear poppies. Oh, yes, I had better not forget to point a finger at the plant taxonomist. I was appalled when I discovered how many specimens we had in the Intermountain Herbarium. It is well known that numbers of specimens in a herbarium are no indication of rarity.

Another step in preserving a rare species may be in attempting to cultivate plants in

identical habitats or very similar to the original ones. This would involve attempts to germinate seeds for transplanting of garden or greenhouse-grown plants and transplanting growing plants from natural habitats. This does not excite me, as we have attempted to grow several rare species. Leila M. Shultz, curator of the Intermountain Herbarium, succeeded in germinating seeds of the rare *Sphaeromeria ruthiae* Holmgren, Shultz, and Lowrey from Zion National Park. At the present time, we have two potted plants growing in my home greenhouse in soil from the type locality. After two years of vacillating from "Looking good" to "Will they make it?" I begin to wonder if my specimens will ever flower. So many things come to mind. What about solar radiation, length of day, and on and on? I have successfully transplanted and multiplied *Cypripedium calceolus* L. from the mouth of the Logan Canyon that was in the way of a new home. I have divided the clumps several times and even moved the entire population when we moved from our old Logan home to a site near the base of the mountain just north of the mouth of Logan Canyon. There are more plants today in my garden than the original population contained 35 years ago. I have thought of moving a few plants to sites in Logan Canyon to habitats that would probably support this lovely orchid, but I hesitate when I think of the pressure of every foot of bank area along Logan River by fishermen. The plants I am growing represent the only known living plants of this species in Utah. Extirpation would once again remove a species from the wild that ranged from Logan to Provo when the Mormon pioneers came to Utah.

I have attempted to grow the rare heterostylous *Primula maguirei* Williams that is known only from a nine-mile stretch in Logan Canyon and consisting of only seven known populations. Plants flowered the first year and emerged the second year without flowering, and, after languishing for a short time, disappeared from my garden spot, which I had thought was quite similar to the canyon habitats. I hope to see a graduate student work out the biology of *Primula maguirei* in the near future. Howard Irwin reports that the New York Botanical Garden

recently got a grant to conduct studies of the New York Monkshood, *Aconitum novaboracense* A. Gray, initially to determine its distribution and also to get some biological study underway. This unusual monkshood is presently known from a few localities. This is the way to go, and sometime in the future we will have hard data to give us a better understanding of past and present histories of floras and species.

The most important strategy of all has to be for us to win public support and thereby gain support of elected officials on all levels. Unless we gain this support, there will be no funding for the work that is just beginning.

We have made gains since Earth Day, 22 April 1970, but in other important ways, we have lost ground (no pun intended here). The radical rhetoric of street protests has been replaced by legal briefs. There are probably more than 8 million members of environmental groups who make contributions totaling nearly 70 million dollars a year. The Audubon Society and Sierra Club were the first of the conservation groups, but they have been joined by many more. State native plant societies are organizing, with several new societies each year. We know of the accomplishments in California and what the potentialities are. We have just organized a Utah Native Plant Society. This is the way we can get our message to the state and local levels.

I share the anxiety of Howard Irwin, Walt Macior, and Dieter Wilken in preserving rare species; but, in the meantime, we cannot be sympathetic with those who would preserve them only as instruments for political strategy. Those who have taken strong stands pro or con without sufficient knowledge have hurt our cause. In the meantime, let's study our rare species intently with qualified, professional botanists.

QUESTIONS TO DR. HOLMGREN

Q. There is a big problem in that information available is not keeping up with the demand. The gentleman from the Forest Service said they had 200 cited to survey and funds to do 20. The problem is even greater in private industry. The company proposes a project and requires a survey and the information is just not generally available. Do you foresee a way out of that dilemma?

A. I just don't see a way out of it. In fact, very often we see proposals or requests for proposals come across our desks and we are supposed to have something in on it a week before the proposals came to us. Sometimes we have about six weeks to work this out. There is no way we can do it. To pretend that some of these things can be done in such a hurry is not being honest with the problems that are at hand. It is going to take some time. Very often these things have been under planning stages for a long, long time, but the problems do not come to us until the last minute. No one plans a \$100 million plant without having gone through a lot of planning, and then in the final stages the requests come across our desks. What can we do? It is going to take some time.

Comment: The Forest Service is developing a policy now that would require all external organizations proposing projects on Forest Service land to hire a professional botanist to inspect the project for T/E species, so we'll get a lot of these covered in that way.

Q. Does the cultivation of plants and plant planning hold a better opportunity than we have experienced with animals?

A. Sometimes it does. Janice Beetley brought in some seeds of *Arctomecon*, and she succeeded in germinating them but they never flowered for her. We know that is a genus where transplanting is an impossibility. It surprises me because so many members of the poppy family can be grown from cuttings, but this particular one defies that. I used to think I could grow anything if I knew the right witchcraft, but I've discovered there are all degrees of absolute success, to the point where you have weeds coming along in your garden to the point of absolute failure on the other end. In my years of experience with native plants, I could plug in something all along the way so that I would go imperceptibly from complete success to failure.

Comment: A comment really to the gentleman's earlier comment. I believe there are a growing number of industrial concerns who recognize the problem of endangered species to the point that they would much rather incorporate biological knowledge earlier in the planning process than face litigation later on. In this way I think there is progress being made in this area.

A. I'm sure there is. I think that is one of the good things about some of the problems we've had along the way that these people have discovered. As they begin to plan, this is one part that has to be in the planning stages right from the very beginning. I think there were references to that in talks we heard yesterday. People are beginning to come to some of these agencies, and Doug Day has had several people come to him and ask for help as they were beginning to plan a study. I think we are going to have more of that to a point where I hope that finally we can get the public on our side. It's going to be a long education, but every day when I pick up newspapers now I read articles by different authors, DeLong and several others, who are writing very well-written essays on the problems we are now facing.

Q. One thing I'm surprised no one has mentioned. I'd like to know if the Fish and Wildlife Service has contacted either BYU or the Internountain Herbarium. At the present time Stan Welsh has computerized all the herbaria for Colorado, Wyoming, North Canada, and North Dakota. Listed in their computer program is every sample surveyed of those herbaria. Any agency or industry person interested in developing a project need simply place a phone call to Fort Collins asking them to print the species list. It has a tremendous option on it. Included on it are all the rare and endangered species in a specific geographic area and I've heard rumors from workshops held in Fort Collins that they plan on expanding this. Have you been contacted about that?

A. I haven't. Have you, Leila Shultz?

Comment: No, but I do have a comment on it. Herbaria standardly have 40 to 70 percent misidentifications and so, as good as the information is, it's nice to have it available. But if you want lots of misinformation you can get it quick.

A. Yes, there are so many people who will look at a herbarium label and the identification on that becomes the gospel truth. We know. We get plants from other institutions that are not even in the right genus, and sometimes the species is a long ways away (but not from the BYU). We're glad we have such good working relationships with all universities.

Comment: I have talked to Colorado State about possibly getting on this system, and, although there are

misidentifications, I think, where you have the computer printout, if something comes out in the distribution very different from what you expect, it comes to your attention in a hurry. I think there is good potential in it.

A. I was trying to get Leila's attention because for the last several years she has been listed as the assistant curator, but I'll have you all know that she is the curator. She's done it all and I've been happy, but sometimes it has given her more than a person ought to carry.

Comment: I have one comment here. Perhaps the information or the lack of information here with regard to the private industries approach to endangered and threatened plants needs to be traded. Until now it hasn't been, so I will take it upon myself to give you my own professional view of it with regard to the private industries I have dealt with. Private industry is willing to cooperate with the endangered species program. They do not wish to interdict any of the endangered or threatened species. They are willing to do what is necessary in order that they may fall in place, but they do need to be able to survive the regulations so that they can carry on their businesses. The problem arises though, not with the private industries, but with the general public. The general public is the place where we really need to do our education job and not with the private industries. The private industries are ordinarily with us.